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R. D. NEIFELD

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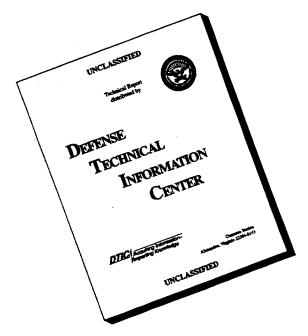
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developed. This method allows	s for accurate measurement of t e of this technique is that it allow	he load-line displacement he accurate determination	ecimen during fatigue cycling has been nt changes that occur as a crack grows n of crack growth behavior throughout
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Fracture mechanics and fatigue liffailed during safe life testing after to perform yield-before-break fraction Serial No. 1659 prior to laboratory were prepared for various sizes of laboratory test, and the pressure of the	109 pro cture an testing defect	essure cycles. Mechanical an alysis. Scanning electron fra and the types of cracking the and applied pressures, include	d fracture properties from the actography was used to detent at occurred during laborator ting the defect size measure	he breech ring ermine the siz v testing. Me	gs were measured and used the of defect present in ring tean fatigue life calculations
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6. AUTHOR(S)			
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		d nenetrator of the 105-mm	C76A1 kinetic energy round. Material
property and inspection results from	the manufacturer of the tungsten as e performed from each of the five nt Research. Development, and Er	alloy penetrator were revieu production lots for the pen agineering Center's test res	etrator. Analysis of the manufacturer's ults failed to identify any defect in the
A penetrator was fatigue tested so a this cracked penetrator was measure	s to produce a 1.6-mm deep cracked to be about one-eighth of that of	in the root of its rearmost an uncracked penetrator.	groove. The bend energy-to-failure of
Results of the tests and analyses ind that failed in firing tests. A recommungsten alloy penetrator.	licate that a crack of about the sam nendation was given to use an eddy	e size as that in the fatigue e-current inspection method	test had been present in the penetrator in future manufacturing of this type of
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6. AUTHOR(S)	•			
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A new technique to evaluate the electrical properties of semiconductor wafers and devices using surface photo-charge voltage (SPCV) measurements is presented. SPCV measures the change in the surface electrical charge induced by a chopped laser light whose photon energy exceeds the band gap energy of the semiconductor sample. This charge is measured capacitatively, thus SPCV measurements do not require the fabrication of metal contacts. In photo-charge voltage spectroscopy measurements, the SPCV is measured as a function of the energy of a sub-band gap monochromatic steady-state illumination, and its derivative spectrum is associated with the density of surface states. A qualitative analysis of the proposed measurement is presented along with experimental results performed on gallium arsenide samples passivated with a thin zinc selenide film of variable thickness. The proposed technique is completely contactless, and it can be used as an in-line nondestructive characterization of semiconductor wafers during the various stages of integrated circuits fabrication.				
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An adaptive finite element method differential equations in one space finite element approximations. Sinexpensive approximation to the successively higher orders to obtain are used to control an adaptive adepending on the dominant computeroretical orders of the numeric keeping the total error within a	e dimension and time. The dif- uperconvergence properties e spatial component of the er- in an approximation of the t- mesh refinement strategy. Re- ponent of the error estimate. cal methods. Computational	ferential equations are and quadratic polynor for. This technique is emporal and total discefinement is perform. Levels of refinement is	mials are used coupled with cretization errored in space, ti	to derive a computationally time integration schemes of ors. The approximate errors me, or both space and time d automatically based on the	
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differential equations in one spa finite element approximations. inexpensive approximation to the successively higher orders to ob- mesh equidistribution schemes to or finite element mesh so that a system of ordinary differential unstable with respect to an e- determining the stability of a pa-	sce dimension and time. The difference of the spatial component of the error otain an approximation of the terror time-dependent partial difference a given quantity is uniform over all equations for the mesh velociting quidistributing mesh when the	erential equations are discre- ind quadratic polynomials a or. This technique is couple imporal and total discretiza intial equations is studied. The the domain. Mesh moving es are considered and some partial differential system and the construction of state	r vector systems of parabolic partial tized in space using piecewise linear re used to derive a computationally ed with time integration schemes of tion errors. The stability of several he schemes move a finite difference methods that are based on solving e of these methods are shown to be is dissipative. Simple criteria for the differential systems for the mesh as are present.
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Several medium and high strength al alloy steel, have been heat treated to Charpy impact energy. The correlati Underwood suggests that for A723 limitation of their study was that temperature. This study evaluates C utilizing these correlations. Results at room temperature, and tends to ut one instance, was a conservative esting the results presented in this study, it is the Ault-Wald-Bertolo correlation we	various strength and toughness ons investigated included those steel, the Rolfe-Novak correlated the Charpy impact energy was charpy impact energy and tought of this study indicate that the Ruderpredict the measured fracture to street a recommended that if a correlations investigated the street of the street	levels and evaluated for one of Rolfe-Novak and Aultion predicts the fracture measured at -40°F, wheness at both room temperation of the toughness at -40°F. The algebras of the material at ion is necessary for estimates	correlations be. Wald-Bertok toughness re reas the toug ature and at -verpredicts the Ault-Wald both room ter	etween fracture toughness and of Previous work by Kapp and asonably well. One potential hness was evaluated at room 40°F and considers both when a measured fracture toughness-Bertolo correlation, in all but appearature and -40°F. Utilizing
14. SUBJECT TERMS				15. NUMBER OF PAGES
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Fatigue life tests were perform treatments and resulting residual different depths and surface value of comboth the deepest and the higher life agreed well with measurem growth properties of the mater magnitude of the residual stress life plot, where the ΔK is for a strelationship between ΔK and fat types of residual stress, indicating similar conditions.	Il stress: shot peening, hole swagi lues of residual stress near the in inpressive residual stress. The hist surface value residual stress and ients. The calculations accountial; the shallow surface-crack of distribution. A consistent describility of the stress of the contract of the c	ing, and tensile overload. In otch root and different faighest life was measured distribution. Fracture meted for the following fact configuration; the applied ription of fatigue life was at and in the region of comesults from both the untrestant of the same	The three treatments fatigue lives depending from overload special echanics-based calculors that affect fatigue loading; and the dobtained from a ΔK appressive residual streated notches and the confidence for tests	s produced widely ing mainly on the imens, which had alations of fatigue ue life: the crack epth and surface versus calculated ess. A power-law ose with the three s under generally
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Royce W. Soanes				
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If r is the profile or radius function for a surface of revolution and r_o is the polar radius function, a quasi-geodesic path on the surface can be defined by the generalized Clairaut relation $rSinw = r_o$, where w is the meridional angle. An inequality involving r_o , r_o , r_o , and r_o is derived. The global satisfaction of this inequality guarantees the windability of the path on a convex ($r^{\prime\prime} < 0$) surface by a filament winding machine. If the surface is concave anywhere ($r^{\prime\prime} > 0$) and a more well known "clinging" inequality is also satisfied, windability is also guaranteed. By "windable" we mean that the winding data produced from the path represents a single-valued function and that the wound filament does not bridge. In addition to this new windability criterion, simplified methods for generating quasi-geodesic paths and properly scaled winding data are also presented.				
14. SUBJECT TERMS	Differential Geometry Surface of	of Revolution	15. NUMBER OF PAGES 21	
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Emission spectroscopy appears to adequately screen noncritical standard stock metals with their wide constituent tolerances. For this work, the Angstrom model V-70 direct reading vacuum emission spectrometer was used to perform computer-assisted chemical characterization of gun steel materials. The development of multi-element calibration data, spectral interference corrections, matrix interference corrections, and system operating condition corrections are discussed. Unfortunately, even fully optimized emission spectroscopy completely fails to chemically characterize critical service intensive metals, such as gun steel, with their narrow constituent tolerances. For gun steel, the respective required concentration ranges (weight percent), required precisions at 95 percent confidence (weight percent), and achieved precisions at 95 percent confidence (weight percent, optimized emission spectroscopy) are: carbon = 0.30 to 0.38, ±0.01, ±0.02; nickel = 2.00 to 3.50, ±0.05, ±0.10; phosphorus = 0.001 to 0.014, ±0.001, ±0.002; sulfur = 0.001 to 0.012, ±0.001, ±0.003; chromium = 0.80 to 1.20, ±0.05, ±0.10; manganese = 0.50 to 0.70, ±0.02, ±0.06; molybdenum = 0.40 to 0.60, ±0.02, ±0.03; vanadium = 0.080 to 0.120, ±0.005, ±0.030; silicon = 0.15 to 0.30, ±0.01, ±0.02; aluminum = 0.001 to 0.010, ±0.001, ±0.005; and titanium = 0.001 to 0.015, ±0.001, ±0.001, ±0.017. Optimized emission spectroscopy inadequately characterizes gun steel to the desired level of precision. Although they are more time-consuming, inductively coupled plasma and carbon/sulfur analyzer benchmark methods are strongly recommended for all future gun steel material analyses due to their very desirable levels of precision.				
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compute the rifling curve which	will produce a projectile torque	e curve of virtually any d	lesired shape.	
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the trajectory of the projectile increases projectile velocity, the deflections during firing are recessary to establish a mominimize muzzle deflection.	e. As the propellant temperature has affecting range, accuracy, and elated to projectile velocities, whi re accurate estimate of the prop	e varies, its burn rate also varies, its burn rate also value of penetrating capability for ch in turn relate to the propellant temperature at the tapproach that can be used to	he dynamics of a cannon and thus aries. A faster burning propellant kinetic energy projectiles. Muzzle pellant temperature. Therefore, it me of ignition to account for and o develop an emulator design. An
14. SUBJECT TERMS Thermal Emulator, Temperate	ure Gage		15. NUMBER OF PAGES 11 16. PRICE CODE
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test and analysis procedures. Notched two carbon fiber/epoxy materials, a rel 2-mm and 4-mm; and three specimen specimen with arm height-to-specimen specimen including those for stress in	d specimens were tested on atively brittle T300 fiber/97 configurations, the standard m width ratio of 1.9. Stress tensity factor, K. and crack	to types of symmetric for epoxy and a tougher As three-point bend and cor and displacement express- mouth opening displacer	e of developing translaminar fracture toughner al layups, quasi-isotropic [0/45/90] and [0/90 64 fiber/977-2 epoxy; two laminate thicknesses impact configurations, and an extended compa- ssions were obtained for the extended compa- ment, V, in terms of relative notch length, a/v and off-axis cracking for the extended compa-
damage in the bend specimen. Two to the notch in predominantly 0° fiber K at maximum load, K _{max} , determined as a measure of fracture toughness. measurements of fracture toughness.	types of notch-tip damage layups, and that which occur I in a way that took accoun For deviations from the This criterion also excluded arm breakage and load-poir	were characterized using are ahead of the notch in quant of the effective crack go linear P-V plot correspond tests with damage of the at damage noted in the test	the standard compact specimen and load-poradiography, that which extends perpendicularisisotropic and 90° fiber layups. The application of the maximum load point, was usually to $\Delta a/W \leq 0.04$, K_{max} gave consistently that violates the basic concept of fraction. Plots of K_{max} versus $\Delta a/W$ showed increasing the predominantly 90° fiber layups.

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weaponry is extremely accurate can should embrace the mindse zero' concept brought about be entire fleet using only a few t determined. Therefore, for the that contributes to accuracy) may a comprehensive study into the their effect upon dynamics at the in the early 1990s. Modelling in the overall goal is to provide a jump offset for a specific round randomly drawn from an expect of output responses having its distribution. For the test data	an important aspect of current, we should not embrace the rest that the best in tank gun accept the downsizing trend in toda anks and gun tubes. The confector to work, variability ust be minimized or accounted the relationship among the character and shot accuracy, is performed using Benét's guinning point correction factors and ballistic load. In this type ted statistical distribution. The own characteristics. The like used and the analysis run, fifther prediction. Further study included across the full family of round found accuracy, Modal Analysis.	nindset that the best in tank uracy has been achieved. Way's army means that zeroin ntribution of individual tubin tube-to-tube manufactured for through the use of compacteristics of gun tubes, projecteristics of gun tubes, and gun tubes of tubes, and gun tubes	iques. Even though our mechanized gun accuracy has been achieved. We be can and should do more! The 'fleet ag exercises will be conducted for the best to a tank's accuracy is no longer to (or more importantly the variability puter simulation. This report presents ectiles, gun mounts, and ballistics and the dynamic index tube test conducted tently purchased gun vibrations code. It is an an empirically determined exit ancertain or unknown parameters are of input values results in a distribution curs is cast in terms of a probability now promise for the use of this semitubes is recommended with the intent
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Sections of camon tubes with inner radius of 53, 60, and 78 mm were cycled from near zero to 100 to 300 MPa internal pressure until fatigue failure occurred. The failure locations were along 2-mm holes cut through the camon wall at a 30° angle to the tube axis, for the purpose of evacuating combustion gases from the camon after firing. The camons had various amounts of autofrettage by overstraining, including 0, 30, 50, and 100 percent. The amount of overstrain affected both the initiation position of the fatigue crack along the evacuator hole and the measured fatigue life. Increasing the amount of overstrain moved the crack initiation from the tube inner radius toward a midwall position and significantly increased fatigue life. Fracture mechanics and solid mechanics-based calculations of fatigue life were performed for comparison with the measured lives. The calculations gave a good description of the measured life, taking account of tube configuration, applied pressure, amount of overstrain, stress concentration of the hole, crack size and shape, material fatigue crack rate behavior and yield strength, and pressure in the hole and on the crack surfaces. As with measured fatigue life, the calculated life was significantly affected by the amount of autofrettage of the tube. The ratio of outer-to-inner radius of the tube and the presence of pressure in the evacuator hole also had substantial effects on the calculated fatigue life.						
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LV. Meisel						
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13. ABSTRACT (Maximum 200 words) This report, in conjunction with its multivector analysis package, provides: (1) a brief introduction to the ideas and features of the 8-dimensional geometric algebra G(3) defined on 3-space; (2) a code for performing geometric algebra analysis; (3) examples of the operation of the code; and (4) applications of geometric algebra to the solution of multivector equations and to rotation operations in 3-space.						
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A monitor has been designed to detectechnology was developed to detect sensor data and activates a remote seizure activity, therefore, false all differentiating seizure activity from	tect the onset of status epilepticus at the minor, barely perceptible trem tetherless alarm when a seizure is d arms do occur. Neural networks h a casual motion. The network uses	ors characteristic of parti etected. However, the se tave been studied as a m elements of the normalize	artial seizures in children. A unique sensor al seizures. A microcontroller analyzes the nsor response is similar for both casual and leans of analyzing the sensor response and zed power spectrum of the response data as ccurately detecting seizures than the method
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modules by straigh	play roles in tenso atforward transcrip	ption of their defining equation	ons. The built-in function	e tensors, are coded as <i>Mathematica</i> as can then be used to perform tensor ated by examples from Schwarzchild	
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H.T. Nagamatsu, L.N. Myrabo, D. C. Ekonomidis, M. Greenman, P.				
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13. ABSTRACT (Maximum 200 words) The charge and discharge cycles Institute (RPI) High Pressure Sho pressure shock tube, a 65 percent diaphragms are placed over the ex- is 91 psia, and the flow Mach num to-bore pressure up to 2300. The restriction at the exit of the charge discharge ports varies from 0.51 a across the evacuator ports, shock coefficient for the ejector ports is model of the 155-mm gun bore e with six staggered ejector ports is of approximately 20 percent in coefficients for the baseline and than 26 psig, and the coefficient	ck Tube and Steady-State It scale model of the bore racuator charge and dischaber is 0.89. The evacuator me charge coefficient for the ports, the charge coefficient for the ports, the charge coefficient at a P _B /P ₀ of 4 to 0.58 at a waves with high temperatures approximately 0.72 for an approximately 0.72 for an approximately 0.72 for an approximately of the baseline of the mass flow augmentates the mass flow augmentates the staggered ejectors are near	Flow Facilities. To evacuator is install rge ports. The prespressure is varied the charge ports in the charge ports. Dures behind the way a evacuator pressure RPI Steady-State configuration. The ion ratio over test thy constant at app	test the charge and ed on the end of t sture behind the Marco obtain ratios of the the baseline concely 0.40. The chararing the charge phases are present in the range of 50 to 1 Flow Facility, and staggered ejector of the pressures from 1 proximately 0.80 for	he shock tube. Thin plastic ach 1.89 incident shock wave he initial evacuator pressure-figuration is 0.29. With no ge coefficient for the angled ase with high pressure ratios he evacuator. The discharge 95 psia. A 33 percent scale the performance of a model onfiguration results in a gain to 84 psig. The discharge
14. SUBJECT TERMS 155-mm Self-Propelled Howitzer	, Gas Dynamics, Model B	ore Evacuator Per	formance,	15. NUMBER OF PAGES 74
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elastic strains that develop as a res cases. They show that a significar depending on the lay-up and cure of Several possible solutions are prese	sult of g nt residu rycle, lar ented. Tension	un barrel manufacture and nal stress state will exist be ge localized stresses can be a simple technique for mea- levels up to 7 pounds were	field use is presented. Nu cause of the filament wind generated which could cause suring the tension during fire employed successfully in	rformed. A technique for calculating the americal results were obtained for several ding processing technique. Furthermore, use defects such as longitudinal wrinkles. Elament winding was developed and used in the experiments. The use of such high
14. SUBJECT TERMS				15. NUMBER OF PAGES
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John H. Underwood						
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In this report two methods of fracture analysis of welds will be emphasized, one addressing fatigue life testing and analysis of notches at welds, and the other addressing the final fracture of the welded component and the fracture toughness tests used to characterize final fracture. These fatigue and fracture methods will be described by referring to recent work from the technical literature and from the U.S. Army Armament Research, Development, and Engineering Center, primarily fracture case study and fracture test method development investigations. A brief general summary will be given of fatigue and fracture methods and concepts that have application to welded structures. Specific fatigue crack initiation tests and analysis methods will be presented, using example results from a welded stainless steel box beam of a cannon carriage. Recent improvements and simplifications in J-integral fracture toughness tests will be described, particularly those related to welds. Fracture toughness measurements for various stainless steel weld metals and heat treatments will also be described.						
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of fracturefast fracture, fatigue tests and related analyses that hand carbon/epoxy laminates.	dly applied to failure of armamer e cracking, and environmentally-a nave been useful to characterize fr	ssisted cracking. This repo acture in armament compose toughness, notch fatigu	ed by each of the three general types out describes some fracture mechanics onents made from high strength steels are life, and environmentally-assisted nates.
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hardness, electrical conductivity and tantalum compounds, such high pressure, high temperature were reactively sputtered-depo determined that body-centered- cubic (fcc) tantalum carbide was carbide was deposited at the tra size, preferred orientations, dep	y, good adhesion, thermal stability as tantalum nitride and tantalum, and aggressive chemical envirors posited from argon plasmas concubic (bcc) tantalum was deposited deposited at methane concentral insitional 22 percent methane concentral	ty, and high plasma resistant carbide are being consideration of the bore. In this taining methane. Nondered at methane concentrations above 25 percent, and accentration. Coating compand temperature coefficients.	wear resistance, high melting point, nee properties. Sputtered tantalum ared as future coatings to endure the work, tantalum and tantalum carbide estructive x-ray diffraction analysis ons below 20 percent, face-centered a mixture of tantalum and tantalum osition, crystalline structure, particle to of resistivity are sensitive functions	
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•	ementations of the correlation into	egral and the Badii-Politi mu	ltifractal analysis algorithms are
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suggest that a natural general	ization of the Badii-Politi approac		
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In this report, the effects of ion impla contraction chromium were plated out keV. The dose was varied from 9.4 x 500°C. SIMS and AES analyses, Kno on the surface properties of the chrom	to samples of 4340 grade at 10 ¹⁵ to 3.1 x 10 ¹⁶ atoms/cop microhardness, and pinium plating.	steel an cm² and n-on-dis	d subsequently impli- the implantations with wear testing were	anted with N ₂ * vere conducted used to study	or Ar' at atom energies of 73 at both room temperature and the effects of ion implantation
The greatest improvement in the proproperties improved with an increasing in the coefficient of friction and a mer with nitrogen at elevated temperature at the same condition. The elevated temperature, nitrogen implantations, the	g nitrogen dose. For both a surable decrease in the we showed improved friction a imperature implantations all the hardness was increased.	kinds of ear rate. and wes iso appe three ti	At the intermediate r properties compare ared to decrease the mes that of the unim	e doses tested, and to the room hardness of the uplanted hard co	on resulted in a 50% reduction some of the samples implanted temperature samples implanted bulk chromium. For the room thromium and slightly less that
twice that of the unimplanted low c approximately 40 at% for both the ro	ontraction chromium. At	t the hi	ghest dose tested, th	he maximum i	nitrogen concentration reached
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Two types of ASTM A723 steels I	have be	en investigated for their low	cycle fatigue behavio	or (less than 10	cycles to failure). Specimens
were tested in four-point bending,	both w	vith and without notches, and	the measured fatigue	e lives were con	mpared with those predicted by
Neuber notch analysis (classic and	d elast	ic/plastic remote applied los	ding), and standard	fracture mecha	nics life prediction techniques.
Comparison of measured and pred	licted l	ives indicates that the elastic	/plastic Neuber analy	sis underpredic	ets the measured fatigue life by
as much as 67 percent at large stra	ins, an	d becomes a better predictor	of life as the applied	strains decreas	se. The elastic Neuber analysis
also underpredicts the measured fa	atigue l	ives by 45 percent at large a	polied strains, but see	ems to accurate	ely redict lives at reversals to
failure greater than 100. The frac	ture m	echanics approach assumes e	lastic stresses at the	crack tip, and a	predicts lives within 30 percent
over the full range of strains inves				orma up, are j	products trees within 50 percent
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The results show that the Neuber	notch	analysis is not as good on it	dicator of the low or	vole fetigue be	herring of A722 stable as in the
fracture mechanics life prediction to	echnia	ue. As the life musles to fail	medical of the New C	yere rangue ce.	navior of A/23 steels as is the
times more conservative than those	- ATTOM	imentally manual Since ti	re decreases, ale Ned	ioer analysis pr	edicus lives that are two to three
fully electic stress based are sen	: exper	inemany measured. Since the	e tracure mechanics	approach and	the clastic Neuber approach are
fully elastic stress-based, one can o			, an elastic-based life	predictions tec	chnique works even through we
are believed to be in a plastically-	aomini	ited regime.			
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diameter to tensile at the outsid treated previously. In order to measured as a function of radia load to indent the sample surfa techniques. From a model prop of plastic deformation was deriv we saw that the effect of resi deformation: plastic deformatio is enhanced for a tensile residu- is detectable for the tests using (i.e., less total plastic deformatic hardness dependence on residu-	ill of a hollow steel cylinder that e diameter. The question of how generalize the previously devel position using various hardness ce to measure its hardness. Thosed by Frankel, Abbate, and Sceed, and the experimental depend dual stress on measured hardness is increal stress, therefore the measured larger loads, R_C and Rockwell-Don). The Rockwell-A (R_A) and that stress. We point out that (a) It residual stress can affect the residual stress can affect t	with the Rockwell-C (R _C) had also beloped concepts, in this testers. Each of the harm the residual stress of the same holz, the relationship between the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the effect as the same from the same from the same from the effect as the same from the s	varies from compressive at the inside ardness varies with residual stress was report the hardness in the wall was dness testers used a different applied ample was measured using ultrasonic ween the residual stress and the onset cress was shown. From previous work act of stress on the onset of plastic estimates on the onset of plastic estimates, and plastic deformation from this work, we see that the effect and out for the tests using lower loads and Vickers indenters did not show the -D hardness tests on gun steel should kwell-C and Rockwell-D tests can be
14 SUBJECT TERMS Residual Stress, Hardness, Plas	tic Deformation, Yield Criteria,	Ultrasonic Inspection	15. NUMBER OF PAGES 28 16. PRICE CODE
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6. AUTHOR(S)					
Stuart Dunn*, Samuel Sopok, Dou Peter O'Hara, Gary Nickerson*, at * Software and Engineering Assoc	nd George Pflegl				
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The first known gun barrel thermochemical erosion modeling code is presented. This modeling code provides the necessary missing element needed for developing a generalized gun barrel erosion modeling code that can provide analysis and design information that is unattainable by experiment alone. At the current stage of code development, single-shot comparisons can be made of either the same gun wall material for different rounds or different gun wall materials for the same round. This complex computer analysis is based on rigorous scientific thermochemical erosion considerations that have been validated in the reentry nosetip and rocket nozzle community over the last forty years. The 155-mm M203 Unicannon system example is used to illustrate the five module analyses for chromium and gun steel wall materials for the same round. The first two modules include the standard gun community interior ballistics (XNOVAKTC) and nonideal gas thermochemical equilibrium (BLAKE) codes. The last three modules, significantly modified for gun barrels, include the standard rocket community mass addition boundary layer (TDK/MABL), gas-wall chemistry (TDK/ODE), and wall material ablation conduction erosion (MACE) codes. These five module analyses provide recession, temperature, and heat flux profiles for each material as a function of time and axial position. In addition, this output can be coupled to FEA cracking codes. At the peak heat load axial position, predicted single-shot thermochemical wall erosion showed uncracked gun steel eroded by a factor of one hundred million more than uncracked chromium. For chromium plated gun steel, with its associated crack profile, it appears that gun steel ablation at the chromium cracks leaves unsupported chromium, which is subsequently removed by the high-speed gas flow.					
14. SUBJECT TERMS			15. NUMBER OF PAGES		
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The metal plating industry is constantly	looking for better online pro	ocedures to monitor critic	al process constituents and increase plating

The metal plating industry is constantly looking for better online procedures to monitor critical process constituents and increase plating quality and efficiency. The advantages of online monitoring include direct sampling, process control, bath quality control, data processing, hazardous waste monitoring, chemical reclamation monitoring, and chemical additions. These advantages reduce costs, manpower, and downtime, and improve quality. Three new online titration procedures were developed, tested, and evaluated for the monitoring of sulfuric acid, Cr(III), and Fe(III) in chromium plating solutions. Likewise, one new online titration procedure was developed, tested, and evaluated for the monitoring of Fe(II) in electropolishing solutions. These methods were developed at Benet Laboratories and were tested at Brinkmann Instruments, Inc. (Westbury, NY). In general, these four new online procedures from above are Cr(VI) reduction then ion-selective potentiometric, direct colorimetric, Cr(VI) reduction then complex-formation colorimetric, and direct redox titrations, respectively. The optimum operating tolerances of these four chemical species are 2.5 to 3.5 g/L, 0 to 7.5 g/L, 0 to 7.5 g/L, and 0 to 7.5 g/L, respectively. The first chemical constituent is purposely added, while all other constituents are unwanted low alloy steel plating process by-products. Chromium plating solutions also contain 640 to 730 g/L phosphoric acid and 795 to 895 g/L sulfuric acid. Critical low concentration chemical constituents in the chromium plating process are rapidly monitored using these online titration procedures. These new procedures nearly equal precision and bias of previous offline procedures. The precision, bias, and reliability of these new procedures should be further tested and evaluated for at least a year before adoption. These new online procedures marginally-to-adequately determine critical low concentration constituents in chromium plating process solutions.

14. SUBJECT TERMS Online Chemical Characterization, Online Automatic Titration, Chromium Plating Process Solutions, Critical Low Concentration Constituents, Chromium Plating Solutions, Sulfuric Acid, Trivalent Chromium, Trivalent Iron, Electropolishing Solutions, Divalent Iron			15. NUMBER OF PAGES 23 16. PRICE CODE
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FATIGUE LIFE CALCULATIONS FOR THE 155-MM XM297 CANNON TUBE			CMS No. 6226.24.H180.0 DN No. TU5A5F361ABJ		
6. AUTHOR(5)					
J.H. Underwood, M.J. Audino, and	J.W. Haas				
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Calculations of the likelihood of a safe, yield-before-break fatigue failure and of the expected mean fatigue life at various locations of the 155-mm XM297 cannon tube are described. Yield-before-break calculations are based on the fracture toughness and yield strength properties of two types of ASTM A723 steel. The mean fatigue life calculations are performed for muzzle brake and bore evacuator holes, the evacuator and mount interface notches, the coolant channels, the coolant entry ports, the thread sector notches, and the chamber inner radius. Effects of pressure, autofrettage residual stress, local residual stress, and notch depth and root radius are accounted for in the calculations. Comparisons are made with measured mean fatigue lives from recent hydraulic pressure safe service fatigue life tests of similar cannon tubes. Environmental cracking in areas of coolant access is also assessed. Based on the life calculations and comparisons with mean life from tests, two sets of notches on the tube outer diameter and the coolant channels at midwall are identified as locations of minimum expected mean fatigue life for the cannon tube. Recommendations are given to accomplish an increase in mean fatigue life at these locations.					
14. SUBJECT TERMS		! broom	15. NUMBER OF PAGES 16		
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Traditionally, this problem is solved these traditional measures were found	by using some combination of particular by using some combination of particular by using the problem at har	essure washers and especi ad (the 120-mm M285 syste	excessive vibration and shock loading. ally designed bolts. In the present work, em), and the problem was solved by using are of the bolt-loosening mechanism.
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Four high strength materials, ASTM A Gun (RLPG) Program. Experimental has part of this investigation.	1723, PH 13-8 Mo, AF 1410, and lineat treatments, mechanical proper	inconel 718, were evaluated for ty tests, and environmentally-as	the Regenerative Liquid Propellant sisted cracking tests were conducted
Environmentally-assisted cracking test propellant (LP) at both ambient and respectively. Tests were conducted woof testing.	slightly elevated temperatures (1	75°F). The duration of testing	ng was six months and five hours,
Environmentally-assisted cracking tes both ambient and slightly elevated ten not be determined. Hence, none of the of the six-month ambient temperatur microcracking. This environmental a	nperature (175°F) XM46 LP. Bec e materials tested were highly susce te tests conducted on A723 and	ause no macroscopic cracking to ceptible to XM46 LP for the girn an experimental heat treatment	took place, a valid K _{reac} value could ven test conditions. However, some at of AF 1410 showed evidence of
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An exploratory prototype multi-lug breech block/ring assembly was designed for future projectile launchers. The new geometry redistributes the applied load to several surfaces rather than one surface in conventional breech to react the load. Induced residual stresses from shot peening and overload processes improve fatigue life of the system. In this work, experimental x-ray diffraction residual stress mapping was performed in the lugs of the unaffected portion of a 50 percent overloaded multi-lug breech ring that was fatigue tested to failure. Finite element modelling of a two-dimensional cross section of the breech block/ring assembly was performed using ABAQUS codes on a Convex C-220 computer. Comparisons of experimental residual stresses and finite element analysis (FEA) predictions showed good agreement in the major features of residual stress distribution, especially in the front lug. While FEA predicted the general characteristics of experimental residual stress distribution, experimental residual stresses were deeper and less compressive.					
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are defined as piecewise conics "affine" refers to the fact that w of numerical differentiation using system solved by Newton iterated Newton iteration are obtained based on conic splines is also into of the mathematical machinery bapplicable than global C3 conic pointwise sense. This apparent	and are therefore guaranteed to e make no use of Euclidean dis- ing conics. The nodal derivative ion-each iteration involving the by the aforementioned conic nu- cluded, as well as a discussion of behind conic differentiation and splines are, as well as being co- increase of smoothness beyon. Sketched interpolants reproduce	tance or angle in the disc is for the conic splines sa e solution of a pentadiag merical differentiation. If what we refer to as "sket local C ³ conic splines. Sket imputationally simpler, mad C ³ is obtained through the conics with or without	(convex) data point. These functions f (strictly) convex data. The modifier cussion. We also include a discussion atisfy a locally quadrivariate quadratic conal linear system. Initial values for A discussion of numerical quadrature ached" interpolation, which makes use etched interpolation is more generally here flexible, and smoother in a local a process of re-sketching during the re-sketching. This is to say that if the that conic.
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Calculations of firing stress at severe Measurements of fracture toughness Calculations were made of the ratio condition. Based on the results of the	were performed for seven weld a of applied K to the critical K for	and heat-treat conditions of the 4 for fracture for various combination	130 steel used for the baseplate. ons of firing stress and material	
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The world of interior ballistics has clearly defined zero time point and n peak pressure, but without a clear functions to establish a consistent ti then be combined with the nominal	no clear measure of the length of the zero the time-to-peak is an elusive me reference zero time and a well-o	pressure pulse. The normal be e concept. This work will de defined time-to-peak or time of	allistic plot usually has a rather clear emonstrate the use of mathematical
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There are several industrial processes whereby thick-walled tubes are subjected to uniformly distributed radial stresses in which part of the tube's wall thickness undergoes plastic deformation, while the rest of it remains elastic. The most widely known and intensely studied of these processes is autofrettage. Autofrettage is a process whereby a thick-walled tube is subjected to internal pressurization until, hopefully, an inner sleeve undergoes plastic deformation, while the rest of it remains elastic. Although the investigators of this process are seeking to determine the stress distribution after depressurization, the stress distribution of the tubes under pressure and the corresponding pressure have to be determined in order to arrive at the retained stress distribution. In general, when uniformly distributed radial stresses are acting on the outer (diametrical) surface of a thick-walled tube, the tangential stress component (throughout the tube's wall thickness) has the same sign as the radial component. If, however, uniformly distributed radial stresses are acting on the inner surface of the same tube, the tangential and the radial stress components will be of the opposite sign to each other. In an elastically deformed tube, the magnitude of the tangential stress component increases towards the inner surface regardless of whether the imposed radial stress is at the outer or the inner surface, as well as with increasing magnitude of the imposed radial stress. However, if loaded at the tube's interior after plastic deformation commences, the magnitude of the tangential component decreases (from a maximum at the elastic-plastic interface) towards the tube's inner surface and in very large wall thickness tubes it might reverse its sign (at some intermediary radius between the elastic-plastic interface and the immer surface and in very large wall thickness tubes it might reverse its sign (at some intermediary radius between the elastic-plastic interface and the immer surface) assuming the same sign as that of					
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The thermal oxidative stability of Fi	berite 7714A (glass/epoxy), 976 (ca	rbon/epoxy), and 9//-2 (carbon/e	both short, and long-term heating
up to and above their respective gla The first set of samples was heated	iss transition temperatures. Compo	and the second set of samples to	was evoled for 30-minute intervals
from 200 to 400°C.	for 4-6 nours from 100 to 350 C,	and the second set of samples	, and 0, 0100 101 101 101 1111 1111 1111 111
110m 200 to 400 C.			
The samples were tested in a Perkin-	Elmer TGA7 Thermogravimetric A	nalyzer and weight loss recorded	l. Weight loss data were compared
based on temperature and time at	temperature. The results showed	good thermal stability for each	epoxy material through its glass
transition temperature with a weight	loss of 1.5% or less. The results w	ere comparable for both long- an	d short-term temperature exposure.
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